

SHORT NOTE ON AGROFORESTRY

Shelter belt/Windbreak

A windbreak or shelterbelt is a plantation usually made up of one or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion. They are commonly planted in hedge rows around the edges of fields on farms.

Or,

Shelter belt/ Windbreaks is a wide range of trees, shrubs and grasses planted in rows which go right across the land at right angles to the direction or the prevailing to defect in movement to reduce wind.

Or,

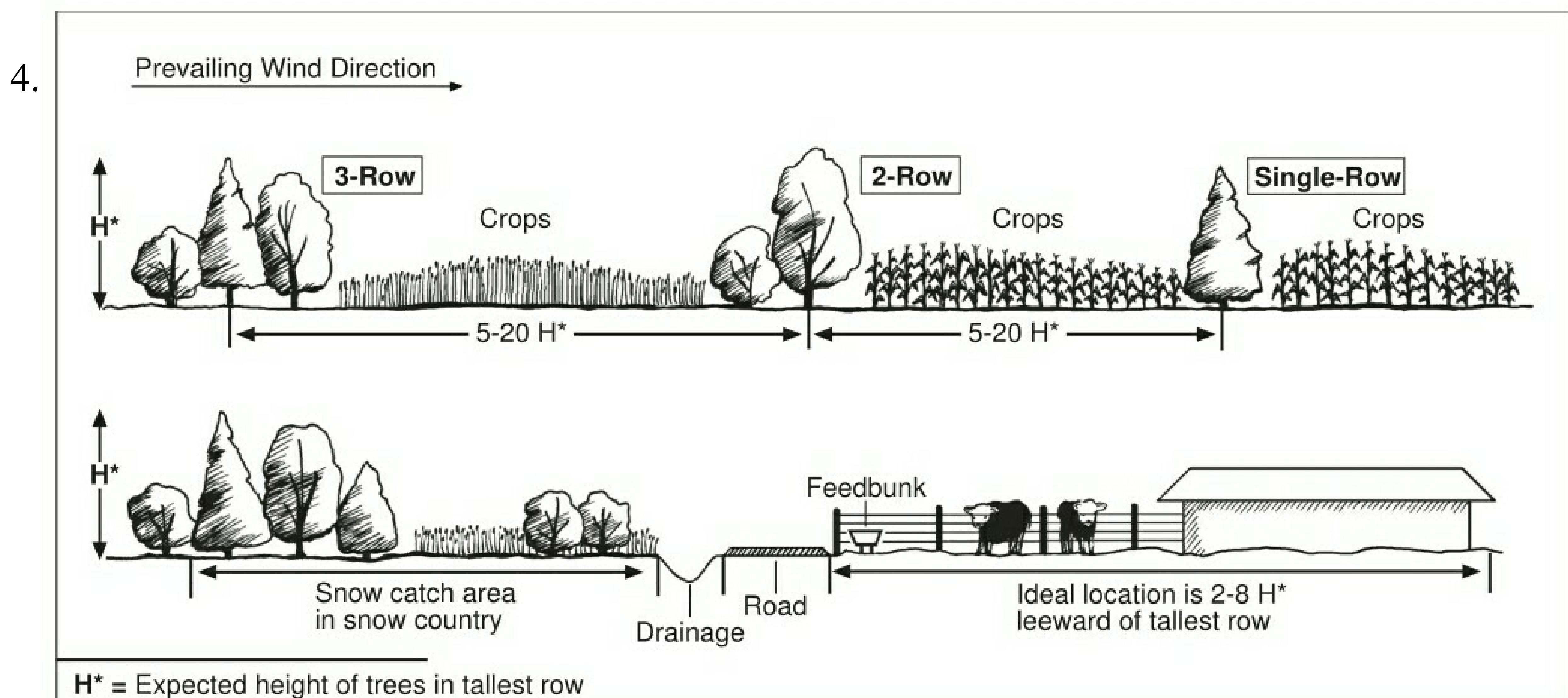
Velocity and to give general protection to cultivated area wind erosion and decreasing effect of hot winds.

Objectives/ Purposes

1. To deflect air currents.
2. To reduce the velocity of winds.
3. To provide general protection to the leeward areas against the effects of wind erosion.
4. To protect the leeward areas from desiccating effects of hot wind.
5. To provide fuel, fodder timber etc.
6. To protect field crops / livestock from cold / hot wind.
7. To prevent soil erosion.
8. To reduce evaporation from farmlands.
9. To improve the microclimate.
10. For fencing and boundary demarcation.

Characteristics/ Design of Shelter Belts

1. Shape and Composition
2. Density and Width
3. Orientation



Shape and Composition

A typical shelter belt has a triangular cross section. This can be done by planting tall trees in the center, flanked on both sides, successfully on other trees, tall shrubs and then low spreading shrubs and grasses. Then there should be a systematic mixture of trees, shrubs and grasses keeping their height, shape, crown form, longevity, and resistance to insect and usefulness in view.

Density of Width

A certain amount of penetrability is desirable in shelter belts. It has been found from experience that though solid walls provide considerable protection immediately behind them on the leeward side the effect disappears after a short distance and there is a great fluctuation in velocity on the leeward side. But in partially penetrable shelter belt the zone of influence is very much greater and velocity curve shows a smooth slowly declining trend. Thus partially penetrable shelter belt is more effective. This penetrable is done by planting trees and shrubs adequate in their rows. The planting of shrubs should be done by 1 to 1.5 m apart and trees 2-5 m apart in rows. The width of shelter belt depends upon climatic condition wind velocity and the soil type. The central arid zone research institute, Jodhpur has advised data in arid zone, wind velocity not exceeds 20 km/hr. A typical belt may consist of 3-5 rows and in the same cases 7 rows may be planted as a distance of 4 m.

Orientation

The orientation of shelter belt depends upon the wind direction and velocity, particularly during the vulnerable season and shelter belt should be oriented as early as possible at right angles to the prevailing wind or to the wind or to the winds that are more damaging to the prevailing time of the year. In case where winds blow from different direction shelter belt should be raised in quarlgeres.

Height and Spacing

Height of shelter belt is more important because it affects the distance to which protection will be given on the leeward side. Higher the trees forming shelter belt, the greater is the beneficial effect on

leeward side. Shelter belt protect the area up to 15 to 20 times the height or belt.

Choice of Species

The choice of species to be raised in shelter belt is by the climate, soil and topography of the area. It is better to grow local species which may serve the object in view, as they can be easily established. The selected species should be fast growing, drought resistant and unpalatable to animal. It should not be leaflets at a time where protection is required.

Species Recommended

The following species are recommended-

Shrubs: *Calotropica*, *procera*, *crotalaria*, *bruhia*, *calligonum*, *polygonum*, *cleistanthus*, *phyllanthus*, *cassia crotolaria*, *dedonaea viscosa*, *jatropha curcas*, *sysambium aculeatum*.

Small Trees: *Acacia jaryumantia*, *Acacia leucophylla*, *Saydora oleodes*.

Trees: *Acacia Arabica*, *A. senegal*, *Albizia lebbek*, *A. orichorda*, *Dalbergia sissoo*, *Lannea coromandelica*, *Prosopis juliflora*, *Progenia pinnata*, *Cucalyptus spp.*

Advantages/ Benefits

1. Moderating effect on temperature. It can increase or decrease the temperature.
2. It can increase the humidity from 1 to 50% because faster evaporation from soil and crops retained due to reduced air movement.
3. It retards the evaporation.
4. It increases the soil moisture.
5. It reduces the wind velocity and wind erosion of soil from the orchard.
6. It increases the fruit production by minimizing wind damage.
7. Field windbreaks protect a variety of wind-sensitive crops, control wind erosion, and increase bee pollination and pesticide effectiveness.
8. Livestock windbreaks help reduce animal stress and mortality, reduce feed consumption, and help reduce visual impacts and odors.
9. Living snow fences keep roads clean of drifting snow and increase driving safety. They can also spread snow evenly across a field, increasing spring soil moisture.
10. It store carbon.
11. Crop yield and economic potential is increase.
12. A wildlife habits is created for birds and insect.
13. Windbreaks improves local environment.

Taungya System

The term "Taungya Cultivation" is Burmas word meaning hill cultivation and the system was started for the first time in Burma in 1856. Then it introduced into Bangladesh (Chittagong and sylhet) in 1870.

The taungya system is defined as a method of establishing a forest crop in temporary association with agricultural crops. It is a method of raising forest plantations in which cultivators are allowed to raise agricultural crops for initial periods of a few years and in return they are made to raise forest plantations.

Or,

A form of agroforestry system in which short term crops are grown in the early years of the plantation of a woody perennials species in order to utilize the land, control weeds, reduce establishment costs, generate early income and stimulate the development of the woody perennials species.

This is a modified term of shifting cultivation in which labour is permitted to raise crop in an area but only side by side with the forest species planted by them. The practices consist of land preparation, tree planting, growing agricultural crop for 1 to 3 years until shade becomes the dense and then moving on to repeat the cycle in a different area.

Traditional Taungya consist of land preparation for tree plantation, growing agricultural crops for 1 to 3 years after the tree plantation and moving on to another area to repeat the cycle.

Types of Taungya

There are three types of Taungya-

- 1. Departmental Taungya:** Under this, agricultural crops and plantation are raised by the forest department. By employing daily paid labours the main aim of raising agricultural crops along with the plantation is to keep along with the land free of unwanted vegetation.
- 2. Leased Taungya:** The forest land is given on lease to the person who affects the highest money for raising Agril. crop for a specialized number of years and ensure care of tree plantation.
- 3. Village Taungya:** This is the most successful of all the three Taungya systems. Under this the people who have settled down in a village inside the forest for this purpose raise crops. Usually each family has about 0.8 to 1.7 ha of land has raise trees and cultivate crops for 3 to 5 years.

Advantages of Taungya System

- i) Artificially regeneration of the forest is done at cheaper rate.
- ii) Problem of unemployment is solved to some extent.
- iii) Better utilization of land.

iv) Remunerative to forest department.

Disadvantages of Taungya System

i) Creates certain legal problems.

ii) Exploitation of hum in labour.

iii) Danger of epidemic.

iv) Provision.

v) Loss and soil fertility.

Procedure

The Taungya system begins with harvesting of the forest. The harvested area is clear cut and burnt. Some trees are after reserved for shade or for fruit. Usually the area selected for Taungya system should be flat and fertile. Generally one or two hectares of land are allocated to one family. Sometimes the amount of area may be more.

Usually cultivation of an agricultural crop is permitted for one or two years before forest plantation. This help the farmer to take one or two good harvest in the highest fertility condition of forest land. Allowing one or two crops before plantation is an incentive to the farmers for clearing the land for forest plantation. When trees crop are planted with agricultural crop in the second or third year, they receive the benefits of the intensive cultural operation on which the farmer adopted for his agricultural crops. When the forest plantation get established, the farmers have to leave the area.

Shifting Cultivation

Shifting Cultivation, also known as slash-and-burn agriculture, is when farmers clear land by slashing vegetation and burning forests and woodlands to create clear land for agricultural purposes. It was a remarkable innovation during primitive cultures and a transition between food gathering and food production. Even in the modern age, the system is widely adopted in different parts of the world. Shifting cultivation was a first step in the direction of food production during early civilization. Shifting cultivation is the oldest system of cultivation of crops. Now shifting cultivation has become a source of ecological degradation, soil erosion and converting good forest areas into waste lands.

Ingty and Goswami (1979) suggest that abrupt change from shifting cultivation to settled cultivation may not succeed due to various problem. Therefore, the shifting cultivators may first be involved in Taungya cultivation and gradually efforts may be made for settled agriculture.

Process of cultivation

First, farmers have to find a designated spot where they want to plant, somewhere that is close to their villages or settlements. Before they can plant, they have to remove the plants and vegetation that

normally covers the land. Using axes and machetes, farmers cut down most of the tall trees, which normally help bring down the smaller trees. Next the farmers burn the debris under carefully controlled conditions. Whenever it rains, the rain comes and washes the fresh ashes into the soil, providing the needed nutrients. The cleared area, is known as a swidden. The cleared land can support crops only up to three years or less. After those three years, the soil nutrients are rapidly depleted and the land becomes too infertile to nourish crops. When the swidden is no longer fertile, the villagers and farmers find a new site to begin clearing out. They leave the old site uncropped for many years, allowing it to go back to its normal vegetation state, this could take up to twenty years.

Crops Of Shifting Cultivation

Most families grow for subsistence purposes, just to eat and live, so one swidden might have a large variety of crops. In other cases, the crops grown by each village vary by local customs and taste. The predominant crops include upland rice in Southeast Asia, maize (corn) and manioc (cassava) in South America, and sorghum in Africa. Yams, sugarcane, plantain, and vegetables are also grown in some regions. These crops have originated in one region of shifting cultivation and have diffused to other regions in recent years.

Advantages

1. It helps used land to get back all lost nutrients and as long as no damage occurs therefore, this form of agriculture is one of the most sustainable methods.
2. The land can be easily recycled or regenerated thus; it receives seeds and nutrients from the nearing vegetation or environment.
3. Shift farming saves a wide range of resources and provides nutrients because a small area is usually cleared and the burned vegetation offers many nutrients.
4. It helps to ensure more productivity and sustainability of agriculture.
5. In shift farming, it is easy to grow crops after the process of slash and burn. This is why shifting agriculture is also popularly known as slash-and-burn farming.
6. It is an environmentally friendly mode of farming as it is organic.
7. Shift cultivation is a mode or form of weed control.
8. It also plays a crucial role in pest control.
9. Soil borne diseases is also reduced significantly through shifting mode of farming.
10. It also reduces the rate of environmental degradation.

Disadvantages

1. It can easily lead to deforestation because when soil fertility is exhausted, farmers move on and clear another small area of the forest.

2. Shift farming can easily cause soil erosion and desertification.
3. It destroys water sheds.
4. Shift farming is uneconomical.
5. It easily leads to loss of biodiversity.
6. Water pollution in coastal areas easily occur because of raw sewage and oil residue.
7. Shifting mode of farming restricts the intensity of land use.

Pollarding

Pollarding is a pruning system in which the upper branches of a tree are removed, promoting a dense head of foliage and branches.

Traditionally, trees were pollarded for one of two reasons- for fodder to feed livestock, or for wood. Deciduous trees and large shrubs respond best to pollarding.

procedure

Cutting off a tree's branches right next to the main trunk is the way pollarding begins. The following year, new growth is cut just above the previous cuts. Sometimes gardeners leave three or five longer branches on the tree, cutting them back each year, too, so twiggy growth erupts from the cut ends. These branches provide more shade than the shorter branches. Over time, the tree develops knobs or knuckles where it was repeatedly pollarded, and the new branches grow from only those knobs. It's important not to cut into the knobs when pruning, and don't cover the tree's cuts with wax or a commercial tree-wound product. A tree heals faster if the cuts are exposed to air. Clean pruning tools with rubbing alcohol between cuts to avoid spreading plant diseases.

Time of Pollarding

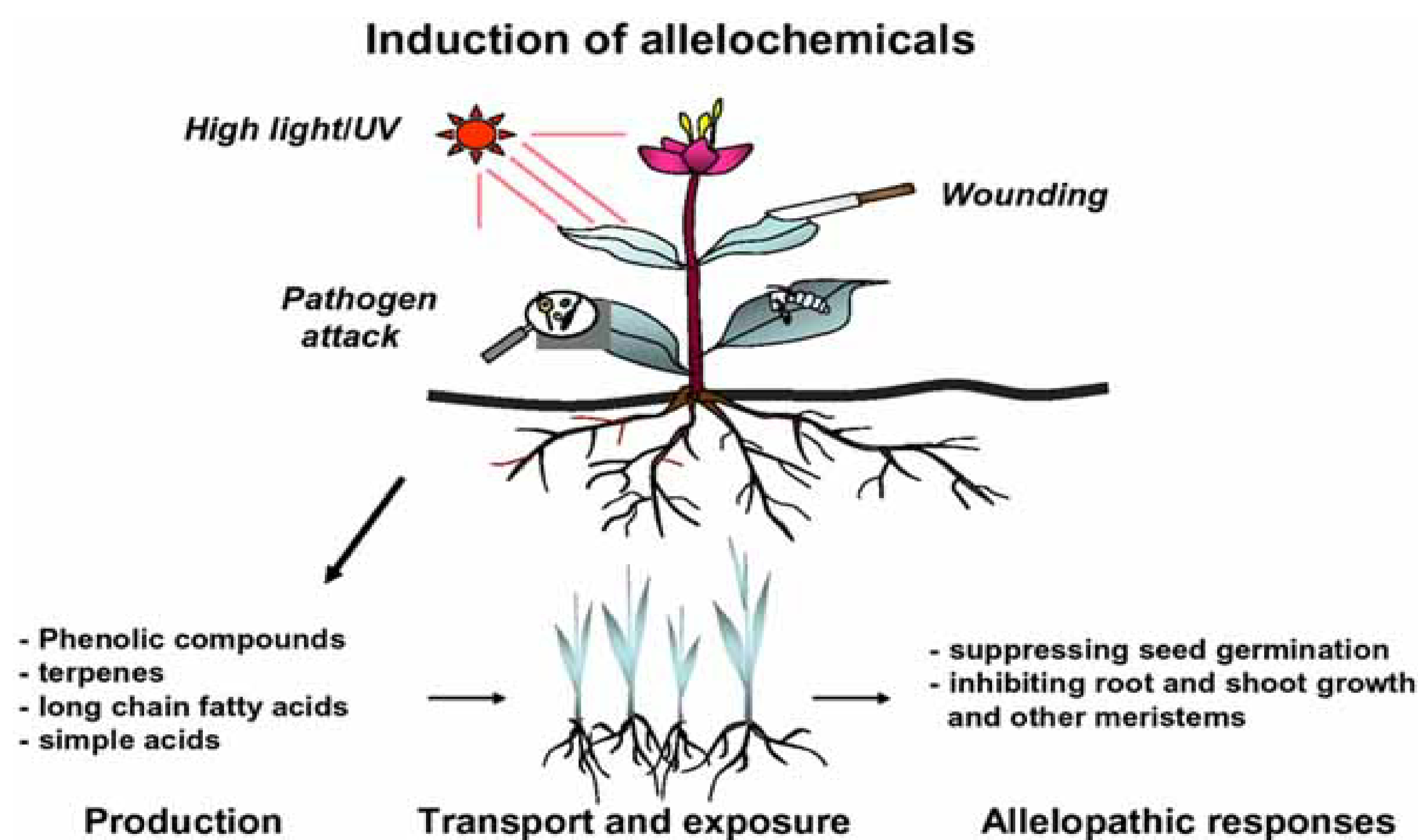
Pollarding is done annually or every other year and needs to start when a tree is still young, once it has reached the desired height. When a tree is pollarded, the technique needs to be continued throughout the tree's life because pollarding produces weak growth. pollarding should be done in late winter or very early spring, when the tree is dormant. The worst time to pollard is in fall because fungus is more apt to enter the cuts then.

Allelopathy

The majority of inhibiting chemicals are produced as secondary substances by plants and released into the soil through the roots or leaf wash. The suppression of growth through the release of chemicals by a higher plant is known as allelopathy. Thus, allelopathy (allelon = each other + pathy = suffering) means chemical control of distribution among plants.

Allelopathic interactions are an important factor in determining species distribution and abundance within plant communities and are also thought to be important in the success of many invasive plants. Allelopathic chemicals can be present in any part of the plant.

They can be found in leaves, flowers, roots, fruits or stems. They can also be found in the surrounding soil. Target species are affected by these toxins in many different ways. The toxic chemicals may inhibit shoot/root growth. They may inhibit nutrient uptake or they may attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient.



Environmental Impact

Allelopathy is a form of chemical competition. The allelopathic plant is competing through "interference" chemicals. Competition by definition takes one of two forms exploitation or interference. When organisms compete with one another, they create the potential for resource limitations and possible extinctions.

Allelopathic plants prevent other plants from using the available resources and thus influence the evolution and distribution of other species. One might say that allelopathic plants control the environments in which they live.

Allelopathic plants

Though a considerable number of plants in nature show allelopathic behavior. Allelopathy is not a common phenomenon for all plant species. Some plants and trees those are well known as allelopathic are Black Walnut (*Juglans nigra*), Ailanthus or Tree-Of-Heaven (*Ailanthus altissima*), Fragrant Sumac (*Rhus aromaticus*), Rice (*Oryza sativa*), Pea (*Pisum sativum*), sorghum etc. Black

walnut is an expert allelopathic plant which contains allelopathic properties within its leaves, buds, roots and nut hulls, it is also known to secrete a substance into the soil called juglone that is a respiratory inhibitor to some plants.

Though most of the allelopathic plants store their chemical weapon, allelochemicals, within their leaves, allelopathic properties can be stored within a number of organs of the allelopathic plants. The allelopathic characters can be found in roots, barks, flowers, fruits, seeds, pollen, foliage etc. of the allelopathic plants.

Advantages of Allelopathy

Allelopathic plants can be introduced in agroecosystems to get some advantages from that-

1. Allelopathy can be used for beneficial purpose through using allelochemicals as natural herbicides or pesticides. Various allelochemicals classes including alkaloids, flavonoids, cyanogenic compounds, cinnamic acid derivatives, benzoxazines, and ethylene and some other seed germination stimulants can be isolated from various families of terrestrial and aquatic plants. These allelochemicals are readily or potentially phytotoxic to many unnecessary plants.
2. Using allelopathic plants in companion cropping may bring a great advantage to an agroecosystem. A selectively allelopathic plant can be used as a companion plant with a certain crop plant. The selectively allelopathic plant will suppress certain weeds and will not disturb the growth of the main crop. The introduction of a number of crop species such as- corn, lupin, oats, beets, wheat, peas, millet, barley, rye etc. in companion cropping has been proved effective in suppressing a number of weeds.
3. Some parasitic weeds produce seeds which germinate in response to chemical compounds released from their hosts. For instance, Striga, a parasitic plant to cereals, germinates in response to p-benzoquinone compound released from its natural host sorghum. Ethylene is also effective to stimulate Striga to germinate. Thus, ethylene can be applied to make Striga germinate in the absence of a host. Using allelochemicals to stimulate the suicidal germination of weed seeds reduces the number of dormant seeds in soil.
4. The allelopathic characteristics of wild types plants can be transferred into the commercial crops to boost up their allelopathic traits for weed suppression.
5. Selectively toxic plant residues can be managed in a proper manner to control weeds efficiently. Using allelopathic crops in crop rotation, cover cropping with smother crops, using phytotoxic mulches etc. can be the examples of some good allelopathic residue management practices.

Alley cropping

Alley cropping is the cultivation of food, forage or specialty crops between rows of trees. It is a larger version of intercropping or companion planting conducted over a longer time scale. Alley cropping can provide profitable opportunities for row crop farmers, hardwood timber growers, nut growers and Christmas tree growers.

Or,

Alley cropping is a farming system in which arable crops are grown in alleys formed by trees or shrubs established mainly to hasten soil fertility restoration and enhance soil productivity.

Objectives

The main objective of alley cropping is to get green and palatable fodder from hedge rows in the dry season and produce reasonable quantum of grain and Stover in the alleys during the rainy/cropping season. some others given below-

1. To Reduces soil erosion when it is established in sloping areas thereby improving water quality.
2. To Improves crop performance from the increased soil productivity from the added organic matter as well as from the microclimate that is created from the crop and tree shading effect. From the improved shading, water use efficiency by plants in increased.
3. To Reduces the use of chemical fertilizers and pesticides. Weeds are better controlled as well as the increased nutrient flow improving the soil fertility without the use of fertilizers.
4. To Minimizes nitrogen leaching hence improving water quality. Nitrogen leached beyond the cropping root zone is often captured by the deeper tree root systems.
5. To Promotes biodiversity.
6. To Maximizes use of the land.

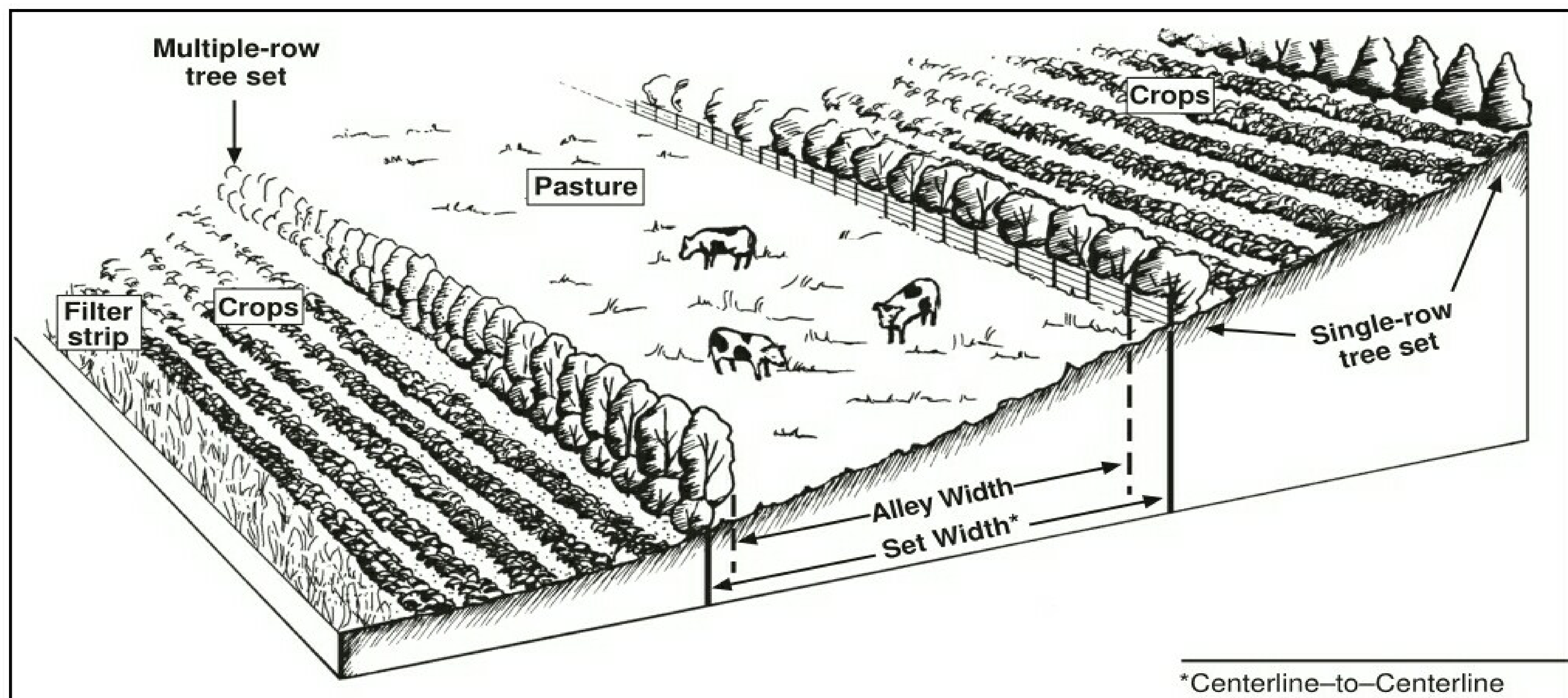
Types of Alley cropping

Three versions of alley cropping system, based on different objectives are-

1. Forage alley cropping.
2. Forage - cum - mulch alley cropping.
3. Forage - cum - pole alley cropping.

In all the three systems crops are grown in the alleys and forage is obtained from lopping of hedge rows. Two components from an essential part of the system these are a) at the hedge rows b) the crop grown in the alley.

Design of Alley Cropping System



Alley width depends on purpose, tree canopy, crop sensitivity, crop rotation, crop or forage grown.

Before beginning this endeavor, a land owner must consider a few things-

- Amount of rainfall.
- Compatibility of trees and shrubs with crops to make sure competition for water, nutrients, and light is minimized.
- Spacing between and within rows.
- Sun Direction.
- Maintenance requirements & available equipment.

Benefits/ Advantages

1. **Income diversification:** Crop production during the years before nut trees come into bearing or hardwood timber is harvested creates cash flow and diversifies farm income, thereby improving the return on long-term investments in trees.
2. **Marginal land improvement:** By planting rows of nut or timber trees on land where annual crop production is low due to erosion or other limitations, marginal crop lands may be converted to higher value wood lands.
3. **Shelter:** Rows of trees reduce wind speed, thereby controlling wind erosion. They also create sheltered microclimates that improves the yield and quality of crops growing in the alleys.
4. **Wildlife:** Alley cropping increases the biodiversity of crop land which creates new habitat for wildlife.
5. It provides higher total biomass per unit area than arable crops alone.

6. It utilizes off season precipitation which otherwise would go waste,.
7. It provides green fodder during the lean period of fodder availability.
8. It provides additional employment opportunities during the off season.
9. When planted along the contours on a sloppy land, it provides a barrier to run off water holds the silt and conserves moisture.

Root Pruning

Root Pruning

It is the process of cutting back long roots to encourage a tree or shrub to form new roots closer to the trunk (common in potted plants too). Tree root pruning is an essential step it are transplanting an established tree or shrub.

Or,

The practice of removing a portion of a tree's root system.

Objectives

1. To increase the uniformity of the stock.
2. To increase the ease of planting.
3. To increase the initial field survival.
4. To stimulate lateral root development.
5. To allow production of seedlings rather than transplants.
6. To Avoid root problems later in time – circling or kinked roots in containers.
7. To Limit the rate of shoot growth for plants growing too fast.

Best time to prune roots

The best time to prune roots is from full bloom until two weeks later. Prune roots only when flowering is sparse or to break a biennial pattern (in the off year).

If flowering is not sparse but the trees still have had too much vigour, prune roots in late November or early December — after the fruit has set and cell division has ended. Do not prune roots when there has been a good fruit set for fear of affecting fruit size.

Factors affecting response of trees to root pruning

- **Root size** : larger roots may generate few new roots.
- **Number of cut roots** : more roots cut means more tree stress.
- **Proximity of cuts to the trunk** : the closer cuts are to the trunk the bigger the impact.
- **Species**: some species tolerate it better than others.
- **Tree age** : old trees are more likely to stress and die.
- **Tree condition** : trees in poor health should not be root pruned.
- **Tree lean**: leaning trees should not be root pruned.
- **Soil type and site drainage** : shallow soils mean stay farther from the trunk.

Advantage

1. Root pruning helps promote fruit growth in several ways. This action assists to create a better rooting system that will supply all the necessary ingredients to the plant.
2. Root pruning eliminates the roots that grow awkwardly, wrapping around the tree trunk and prevent transport of vital nutrients.
3. When root pruning, it is vital to provide a clean cut, a jagged or frayed root is much harder for the plant to repair and provides a much bigger potential area for infection.
4. It Confine the root system to facilitate digging – keep in a smaller volume.
5. It avoid root problems later in time – circling or kinked roots in containers.